

"On the Orientation of the Pyramids and Temples in the Sûdân."

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In the year 1897 I was sent on a mission to the Sûdân by the Trustees of the British Museum, and in 1898 I was again sent to that country to complete the work in the places which I could not reach the year before on account of the unsettled state of that unhappy land. By the favour of Viscount Cromer and Lord Kitchener, the Sirdar of the Egyptian army, I was enabled to visit sites which had not been visited by Europeans for a great many years, and, by the unusual facilities which these gentlemen afforded me, to make notes on matters of scientific interest which have, in recent years, been widely discussed. Besides the examination of the ruins of temples and the copying of the inscriptions which the hand of time had spared, my wish was to collect, so far as possible, accurate information concerning the orientation of the pyramids in the Sûdân, and to obtain measurements of them with special reference to the work which Professor Sir Norman Lockyer and Mr. Penrose have done on the temples of Egypt and Greece respectively.

It will be remembered that a few years ago Sir Norman Lockyer promulgated the theory that Egyptian temples and pyramids were oriented to certain stars, which were sacred to certain Egyptian divinities, and to the sun at certain points of his course. Having worked through all the available material which had been collected by himself and others, he came to the conclusion that his theory was correct, and that with accurate data in his hands concerning a given temple or pyramid, the astronomer would be able to supply the archæologist with a tolerably correct idea of the date when the site was first covered by a religious or funeral edifice. In the 'Dawn of Astronomy' a number of test cases were discussed with results which convinced me of the truth of the theory; and Mr. Penrose, working on the same lines, applied it to the temples of Greece with such remarkable results that my conviction was strengthened. It must, however, be admitted that several difficulties still remain to be cleared away, but I think that these will disappear when the temples and pyramids of Egypt have been measured and surveyed according to modern requirements. For no one can fail to notice that the plans published, even those in the great work of Lepsius, present inaccuracies of a serious kind, especially when we consider that a variation of a few degrees will wreck the most careful calculation. The object of the present paper is to inquire if, and how far, the pyramids of the Sûdân are oriented

according to any definite plan, and to put on record for the use of those interested in the subject such notes and figures as I was able to make.

The pyramid fields of the Sûdân may be enumerated as follows:—(1) Kurru, (2) Zûmâ, (3) Tanâssi, (4) Gebel Barkal, (5) Nûrî or Nawarî, (6) Merâwi, *i.e.*, the Meroë of the Greeks. The pyramids which stood upon these sites of which any remains at all exist are in number about two hundred, and it is quite certain that those which have been destroyed may be reckoned at another two hundred at least. But a pyramid field to be useful for working out the theory of orientation according to a certain plan must possess certain characteristics, such as the following:—(1) The pyramids upon it must be in a good state of preservation at their bases, and all should not, if possible, be oriented in the same direction. (2) One or more temples should be either on or near the pyramid field, so that the direction of the orientation of both kinds of buildings may be readily compared. Now, every pyramid which I have seen in the Sûdân, with the exception of those of Nûrî, consists not of a solid mass of cut stones carefully built up with a funeral chamber inside it, but of a core formed of a mixture of stones, sand, and lime which has been surrounded with a casing of stones, each measuring about 18 inches by 12 inches by 10 inches. It seems to me that the core was first built, and the casing of cut stones put round it afterwards. Curiously enough, every pyramid, with the exception of those at Nûrî, is truncated, and it is this peculiarity which has worked its ruin. For the rain has run through the flat layer of stones at the top in large quantities, and in passing between the stones at the sides, which are built without mortar, has taken with it the lime and sand from the inside; a hollow has thus been formed round the core, and the stones, aided by the furious winds which rage in the Sûdân at certain times of the year, have by their own weight fallen in upon it. Sometimes the casing has been built at too steep an angle, and the upper parts of the sides have fallen in or fallen out, as the case may be.

Yet another reason for the ruin of the Sûdân pyramids must be mentioned. The stones of which the sides are built, unlike the stones which form the pyramids of Egypt, are relatively small, and the natives have found them to be admirably adapted for certain purposes. As a result they have been filched from their places, and used to make the foundations of water-wheel supports and of houses, and also to line the shallow trenches in which the Muhammadans have buried their dead for countless generations. Thus the pyramids have, one by one, been stripped of their stone coverings, and the wind and rain together have beaten the cores so much out of shape that it is sometimes difficult, if not impossible, to distinguish them from small natural hills. The pyramids which have been built in the mountains, or at any great

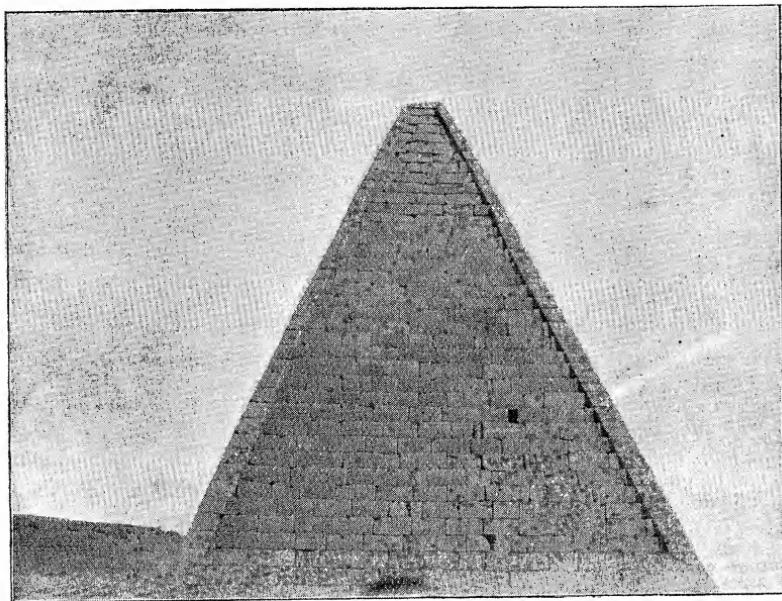
distance from cultivated land, are the best preserved, and this is only what might be expected. When a native wanted stones for any purpose, he went for them to the pyramid which was nearest to him, and the result is that the pyramids which stood near the villages or cultivated land have in some districts quite disappeared. Thus at Tan-kassi, about seven miles from Şenem abû-Dôm, where the Egyptian troops were encamped about eighteen months ago, it is most difficult to identify the cores of the pyramids which once stood there. At Gebel Barkal the pyramids which were nearest to the cultivated land have disappeared, and the same may be said of dozens of the small pyramids which stood at Nûrî. At Meroë the pyramids, which were built near the temple that stood only about a mile from the river, and were in consequence close to the main road which has been the highway to Khartûm and the south for countless generations, have also all but disappeared.

In this way the six pyramid fields of the Sûdân become reduced to three, for those of Kurru, Zûmâ, and Tankassi may well be left out of consideration. It is, however, tolerably clear from the general disposition of the pyramid remains at these places, that the system of orientation employed by the builders of the pyramids there resembled that found to have been in use at Gebel Barkal, Nûrî, and Meroë. With the view of showing the present condition of the pyramids of the three principal fields in the Sûdân, I took about fifty photographs, one of which is reproduced in this paper. Some such record was absolutely necessary, for if the lithographic landscape views printed by Lepsius, in his work the 'Denkmaeler,' be compared with these photographs, the serious deterioration in the condition of the remains since his time will at once be clear.

In the summer of 1897 I arrived at the village of Şenem abû-Dôm, which is situated on the left bank of the Nile, about sixteen hundred miles from the Mediterranean; on the opposite bank lie the villages of Shibba, Merâwi, and Barkal, and on the same side as these, viz., the east bank, a few miles to the south, rises the magnificent rock of sand-stone called Gebel Barkal. Before I began serious work at Gebel Barkal, I visited the pyramids of Nûrî with a view of finding out which was the more promising site. I could not visit the pyramids of Meroë that summer, because all the country round about was in the hands of the Dervishes; I therefore had to content myself with the pyramid fields of Nûrî, Barkal, Tan-kassi, &c.; and with the hope that I might visit Meroë later, I decided that, for several reasons, the pyramid field of Gebel Barkal suited my purpose best, and so began work there.

Gebel Barkal is a huge rock about three hundred feet high; it is three-quarters of a mile long, and is about half a mile wide in its widest part. The widest end has served as a quarry, and all the

stones used in the casings of the pyramids for 10 miles north and south have come from it. Close under the almost perpendicular end of the mountain are the remains of a temple built by Rameses II, King of Egypt, about b.c. 1330; and those of a temple built by Piānkhi, King of Egypt and Ethiopia, about b.c. 730; and those of another built by Tirhakah, King of Ethiopia, about b.c. 680. To the south of the mountain lies the pyramid field, and the remains of the ancient city of Napata must be sought for some five or six miles further south. On the western bank of the Nile there must have stood a great city, with many temples, palaces, and other great buildings, for on several occasions when the Egyptian troops have had to build block houses and other military works, portions of large columns, pottery, &c., have been found in digging out the foundations. The site of this city is probably marked accurately by the modern village of Senem abû-Dôm; and the tombs which were made for the nobles thereof are to be found away back in the desert, at a distance of about two hours from the river, in a range of low sandstone hills.

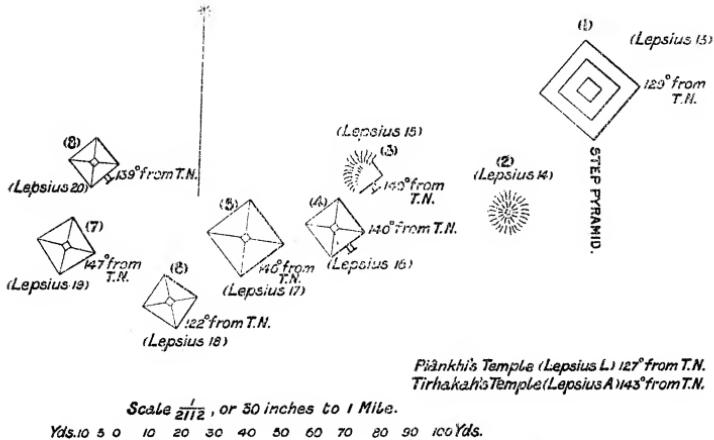


A PYRAMID AT GEBEL BARKAL.

Of the pyramids at Gebel Barkal some are in ruins and some are tolerably complete; the former are useless for purposes of measurement, because the broken sides and the débris round the bases make it impossible to get accurate compass bearings. I therefore made no

attempt to deal with the remains of the pyramids which are scattered about on the rocky plateau on the south side of the mountain, and I limited my inquiry to the seven which stood on the top of it. In Plan I these are set out to a scale of 30 inches to the mile, and thanks to the kindness of Colonel the Hon. M. G. Talbot, R.E., their position is very accurately indicated.* The bearings were taken with a prismatic compass, the variation of which was determined by comparison with an astronomical azimuth; but owing to the irregularities of the masonry, they cannot be relied upon to nearer than 2° . The distances were paced. The variation between the true north and the magnetic north was estimated at $5\frac{1}{2}^\circ$, and this estimate has been confirmed from

PLAN I.



THE PYRAMIDS OF GEBEL BARKAL.

an examination of an Admiralty map,† which I have been so fortunate as to have had placed at my disposal. On looking at the plan, we notice that one pyramid is oriented at 129° from the true north, three

* My friend Colonel Talbot, who was employed by the Egyptian Government to make the triangulation and general survey of the Sûdân for military purposes, obtained astronomical azimuths from time to time, to determine the variation of his compass bearings, and he made use of such data in preparing the two plans which accompany this paper. He employed an azimuth compass. I did not use plumb-lines for finding the alignments, but a steel tape stretched horizontally along the general surface of the pyramid was taken as the direction of each side.

† The Admiralty map here referred to was specially prepared in the Hydrographic Department for the use of Professor Sir Norman Lockyer, and it is now in his possession. It is not a rough reconnaissance made with a prismatic compass, but contains the lines of declination as determined by compass observations made in the Mediterranean, and the Red Sea, and the adjacent waters of the Indian Ocean.

at 140° , one at 122° , one at 147° , and one at 139° . Of all the temples which have been built at the foot of Gebel Barkal only two have any substantial remains, viz., those of Piânhki and Tirhakah; the orientation of the former is 127° from the true north, and that of the latter 143° . Now it seems to me that we may fairly assume that both these kings, with their ancestors and successors, were buried near their temples; indeed from a common-sense point of view there was no place more suitable for their tombs than the neighbouring hill or mountain slope. I searched diligently, hoping that I might find some trace upon some of the blocks of stone which had formed the shrines or funeral chapels that had stood in front of their pyramids, but without success. Every pyramid at Gebel Barkal must have had such a shrine or chapel, but the size of the chapel depended upon the importance of the man whose tomb the pyramid was intended to cover. Pyramids Nos. 6 and 7 on the plan must, judging by the ruins, have had very large shrines enclosed by walls, and we may assume, from the absence of similar buildings in the fronts of the other pyramids, that they were royal tombs. The masonry, however, and the general appearance of them somehow suggest that they were not the oldest of the group, though, arguing from archæological considerations, they should be as old as B.C. 700.

Passing to the most northerly end of the pyramid field of Gebel Barkal, we find lying there the remains of a "step" pyramid, and as it has an entirely different orientation from that of the other pyramids there, and the masonry is of a better class of work, and the whole building is on a scale *sui generis*, it is clear that it belongs to a different period. It is a striking fact that archæological considerations indicate that the pyramids which have different orientations belong to different periods, and at the end of this paper it will be seen that the results deduced from astronomical considerations point the same way.

The official instructions which I received before I went to the Sûdân in 1897 allowed me to make a trial excavation of one pyramid. I therefore selected No. 5 of my plan, as on its shrine there were sculptured scenes in which funeral offerings were being made to the royal personage who had the pyramid built, by priests, by Anubis the god of the dead, and by a number of gods whom it is not easy to identify. This royal personage was assumed to have identified himself with Osiris, and the goddesses who usually attended the god were here seen attending the king or prince. That he was royal there is no doubt, for one relief showed him in the act of grasping the hairy scalps of representatives of a number of captive or subdued nations, and brandishing a Sûdânî club over them, much in the same way as the kings of the XVIIIth and XIXth dynasties of Egypt are depicted on the walls of their tombs and palaces. To indicate the greatness and power of

the king his figure had been made very large, a custom common among savage or semi-savage tribes ; the figures of the vanquished were small, and were huddled together.

To make certain that the mummy chamber was not in the pyramid itself, the stones from one corner, about half way up, were removed, and a boring was made to the length of several feet ; but it was soon evident that the core of the pyramid was not made of masonry, but of stone, sand, lime, &c., roughly mixed together. This being so, the hole was filled up, and the stones replaced in the casing work.

As soon as this trial work was done, by the help of the British officers, about forty men were collected, and, provided with a few tools and a good number of baskets, we began to search for the pit which led to the mummy chamber, which seemed to be below the ground. A trench was dug round all four sides, and at length a large flat slab of hard stone, 10 feet by 6 feet by 10 inches, set in lime, was found on the S.E. side of the pyramid ; this was broken through, and the layers of lime and sand which came beneath showed that we had reached the mouth of the pit or shaft. We toiled through 60 feet of rough concrete in about four weeks, and at length reached a rectangular chamber about 9 feet cube, hewn, like the pit, out of the solid rock ; the roof of this chamber was supported upon square pillars. A narrow passage on the S.E. side of the chamber led into another chamber which had square pillars likewise ; both chambers were half filled with sand. On the sand at the foot of the shaft or pit we found some bleached bones and a broken wine jar, upon which were inscribed the words ΟΙΝΟΣ ΡΟΔΙΟΣ, *i.e.*, "Rhodian wine." The bones were like the bones of a small sheep, but they fell into dust when touched, and I could not therefore bring them home. The broken wine jar is a most interesting object, for it enables us to arrive at the date when it was put into the tomb. We know from several sources that Rhodian wine was used extensively during the latter half of the second century B.C., and the shape of the letters on the jar-neck points to that date. The jar, then, must have been taken up to Gebel Barkal from Alexandria, probably by boat, between B.C. 150 and B.C. 50, and broken in the chamber, which no doubt served as a funeral chapel, at the last feast of offerings held there. I do not think that this date is the date of the building of the pyramid, for it is a well-known fact that commemorative offerings were made in these chapels as long as funds for the purpose were forthcoming. Tombs of royal personages and of people of high rank were kept open by the priests for the express purpose of inducing relatives and friends to contribute offerings, chiefly in kind, at stated seasons of the year, and if a proof be wanted of this statement it is sufficient to refer to Diodorus Siculus,* who says in his history that he visited the halls and the chapels of the royal tombs

* He visited Egypt B.C. 57.

in the Valley of the Kings at Thebes. Now we know that several of these tombs were built 1,300 years before the time of this historian, and yet they were open to the inspection of visitors, even Greeks, at that late date. What the broken wine jar shows us is that the pyramids of Gebel Barkal were not built by late native rulers who flourished under the rule of the Greeks and Romans between B.C. 300 and A.D. 350, but by native kings of the earlier dynasties who followed ancient funeral customs and rites that were known and practised as far back as the XIIth dynasty of Egypt, about B.C. 2500.

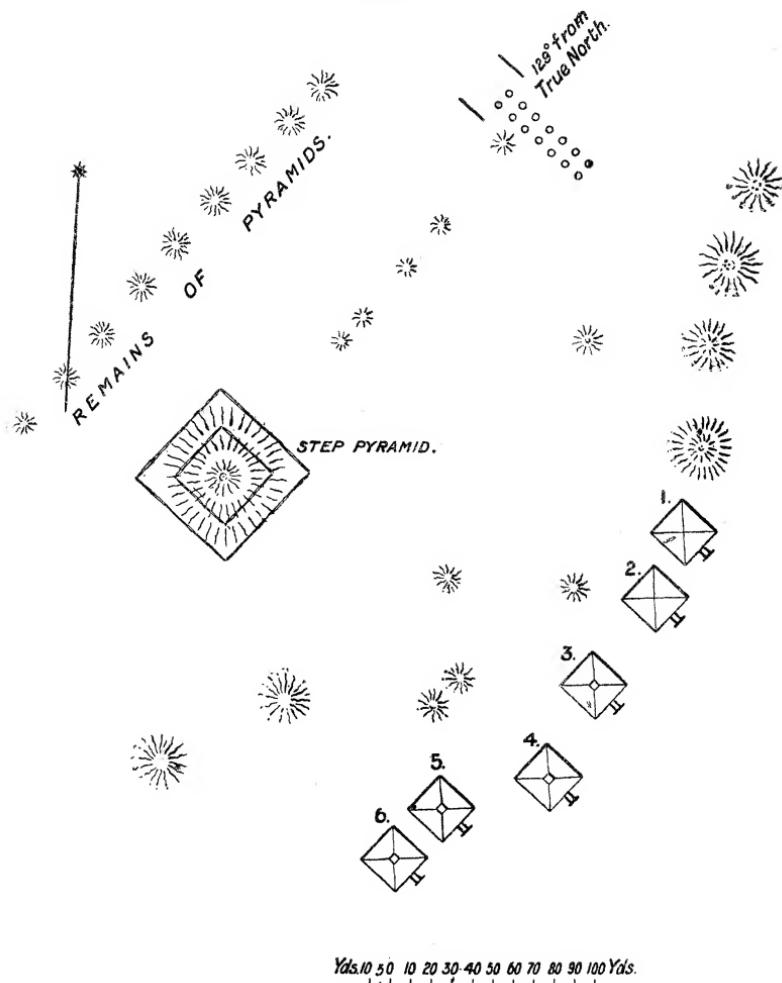
But to return to the excavation. Having removed the sand from the chambers, it became evident that neither the pillars nor the walls thereof had ever been inscribed or sculptured. A diligent search convinced me that the mummy chamber must be situated somewhere under the pyramid, and, judging from the analogy of several tombs which I excavated with General Sir Francis Grenfell, K.C.B., at Aswân in 1886-87, it ought to be exactly under its apex, if such a term may be applied to a truncated pyramid. Therefore, returning to the end of the chamber which had been hewn out of the rock immediately beneath the place where the shrine had stood, we searched for an entrance which would lead us in under the pyramid. At length we found that the wall of the chamber at this end consisted of a slab of stone about 7 feet by 6 feet by 1 foot 2 inches, embedded in lime, and when this was broken through we found a sort of vault, but there was nothing in it. The only thing that remained to do was to cut into the floor of the vault, and when we had done this we found that we had arrived at the mouth of a second pit or shaft, by which the mummy in its coffin must have been lowered into the chamber wherein it was to rest finally. We worked away at clearing out the pit by candle light under great difficulties, and when we were about 100 feet below the base of the pyramid, we began to come near to the short passage at right angles to the pit, which should have led us into the mummy chamber. At this point, however, the sides of the pit became very damp, and everything which we dug out was thoroughly wet; a foot or two lower down the men found themselves in standing water, and at length we had to stop work. We had reached a depth which had brought us down to the level of the Nile, and found that its waters had forced their way by infiltration into the shaft, and presumably into the mummy chamber also. This discovery was most disappointing, and one which I think could hardly have been foreseen. We were, therefore, obliged to be satisfied with having demonstrated the plan upon which the pyramid tomb in the Sûdân was built, and its analogy to the rock-hewn tombs of Egypt of the first twelve dynasties.

Now it is clear that, when the builders of the pyramids at Gebel Barkal selected the site for their tombs on the edge of the sandstone

plateau to the south, it must have been well out of the reach of the infiltration of the Nile waters, for they knew from long experience that the presence of damp was fatal to the preservation of the mummied body. And besides, it is impossible that they should have gone on building pyramid after pyramid at various places on the plateau and on the side which slopes down to the river without finding out that the water of the Nile was making their labour vain. How then can the presence of the water be accounted for? The true answer seems to be that the bed of the Nile has gradually risen since the time when the pyramids were built, and it may be that the river has also somewhat changed its course. A small annual deposit in its bed would easily cause both the rise and the change, of course, and as a result certain sites which originally stood well above the level of the waters of the highest inundation would be flooded from time to time. The cause-way leading to the river and the foremost courtyard of the temple of Piânhî were flooded by the Nile when I was at Gebel Barkal in 1897, and that year the inundation was not by any means one of the highest. Had there been any risk of this happening in Piânhî's time he would never have built, or rebuilt, the temple, which must have been one of the glories of the city of Napata, near the site whereof its remains now lie. Thus we see that in the Sûdân, as in Egypt, the same geological changes have been at work.

Passing now from Gebel Barkal, we have to consider the pyramids of Nûrî, or Belal, which stand on the west bank of the Nile, just opposite to the now famous village of Kassingar, and at about a distance of six miles as the crow flies from Gebel Barkal. The value of the pyramid field of Nûrî for a discussion on the orientation of pyramids is not so great as that of the field of Gebel Barkal; but from other points of view it is of very considerable interest. Its pyramids are not so well preserved, and there is not so much variety of orientation as is usually found in groups of pyramids elsewhere in the Sûdân. The largest of the Nûrî pyramids must, with the exception of the "step" pyramids, have been the largest in the Sûdân, for when complete they cannot have been less than 100 feet high. Several of them are built of hewn stones throughout, and the excellence of the material and the handy sizes of the stones have tempted the natives to use them freely for building tombs for their sheikhs and houses and graves for themselves. Speaking roughly, the group at Nûrî consists of two rows of pyramids, the older row being that in which stand the remains of a large "step" pyramid (see Plan II). The next oldest pyramids stand in a somewhat irregular row about 200 yards to the S.E., and between the two rows a number of pyramids were built at a later date, great care being taken by their builders to place them in such positions that the light from the celestial body to which they were oriented should not be obstructed by the older buildings. The first row of pyramids is in

PLAN II.



THE PYRAMIDS OF NûRÍ.

ruins; with the exception of the "step" pyramid all are small. Of the pyramids in the second row, six are sufficiently well preserved to afford us a good idea of what they were like when complete. They must have stood upon a slightly elevated site, and they could not have been much less than 100 feet in the side; on the S.E. side each pyramid had a shrine or chapel, into the innermost part of which the light from the celestial body to which it was oriented could enter. At each end of the pyramid field was a temple, the size of which it is impossible

to guess at without clearing away the tens of thousands of tons of sand with which the whole site is covered. That at the N.E. end of the field is of considerable interest, for it shows traces of a rebuilding, during which the orientation angle was altered. We have seen that the pyramid field of Gebel Barkal represented the royal necropolis of the city of Napata on the north ; to what city, then, did the pyramids of Nûrî belong ? In the absence of the definite knowledge which can only be obtained by excavating, we shall probably be right in regarding the pyramid field of Nûrî as the royal necropolis of the city the remains of which now lie beneath the sand at Senem-abû-Dôm. This city was certainly older than Napata, and therefore the pyramids which form the tombs of its royal rulers are older than those of Gebel Barkal or of any of the other sites which lie further to the south. A remarkable fact is that all the pyramids at Nûrî, of which tolerably accurate compass bearings can be taken, are oriented 129° from the true north, and that is the angle of orientation of the "step" pyramid at Gebel Barkal. From archaeological considerations the pyramids, including those built with steps, which have this angle of orientation should be older than those which have a different angle. The temples in Nubia and other countries, including Egypt, which have this angle of orientation, are as old as the period which lies between the XIIth and XVIIIth dynasties, and I therefore think that the pyramids of Nûrî, at least the oldest of them, are considerably older than all the pyramids at Gebel Barkal, with the exception of the "step" pyramid. There is another point to mention : the pyramids at Nûrî are on the left bank of the Nile, like all the ancient pyramids of Egypt, and I think this is a strong proof of their great antiquity. With the making of measurements of the pyramids, and a careful examination of the ruined shrines in the hope of finding inscriptions, my work at Nûrî in 1897 came to an end.

Towards the end of last year I left England for the Sûdân, and before the end of December, thanks to the facilities afforded me by the Sirdar, I arrived at the Atbara River. In due course I was sent on to a place called Begrawiyeh, from where I was able to examine the remains of the temples and pyramids which mark the site of the ancient city of Meroë, and of the home of the great queens who ruled there under the name of "Candace." From the spot where I landed, the ruins of the great temple of Meroë are about one and a half miles distant ; by the side of them, running nearly due north and south, is the old Khartûm road, and in a line almost due east lie two groups of pyramids, at a distance of about four and a half miles from the river as the crow flies. The *shâkh* of the district, Muhammed Amîn, who had been an officer of some rank under General Gordon, gave me every assistance in his power, but the country had been so ravaged and wasted by the Dervishes led by Mahmûd under the Khalifa's

orders, that it was with the greatest difficulty that a couple of donkeys were found for us to ride upon. The country is depopulated, and we saw hundreds of well built houses falling into ruins.

The first site visited was that of the temple of Meroë, of which portions of several pillars *in situ* still remain. Before any satisfactory measurements of angles of orientation could be obtained as regards both the temple and the pyramids, I saw that a good deal of excavation and clearing away of *débris* would have to be done; but as no men could be found to do the work—there being none in the country, thanks to Dervish rule—I had to abandon that idea, and get the best results I could from the examination of the ruins only. The temple appears to have been surrounded by a wall which was built at some considerable distance from it, and a very large number of people could have assembled in the space between the wall and the temple. The temple was, like most of the Sūdān temples, dedicated to the Sun-god Āmen-Rā, whose visible type upon earth was the ram, and clearly the ram peculiar to that portion of the Sūdān. Of the shrine nothing remains, but a figure of a ram in hard, bluish-grey stone lay among the ruins of the pillars. The pyramids, over a hundred in number, which are situated at no great distance to the north-east of the temple, are in ruins, and the masonry which still remains is of the same class and style as that of the most recent portions of the temple. At two or three places in the plain round about are remains of buildings of the Roman period, and near one of these was found a small Greek inscription, which I brought home; it is now in the British Museum.

Passing from the riverside ruins we made our way due east towards a chain of very low hills that lay in the distance, and after an hour's ride we arrived at a crescent-shaped eminence which stood with its convex side towards us. The top of the eminence was about eighty feet above the pebbly plain. When I had walked round the pyramids it was easy to see that they must be divided for purposes of examination into three groups. The first group stood on the crescent-shaped eminence mentioned above, and it seems as if this site originally consisted of a series of low hills, from which the tops had been cut off and thrown into the hollows between to make a level base for the pyramids. The first group consisted originally of about twenty-five pyramids. The second group stood away to the south-east, and consisted originally of about twenty-two pyramids. The third group lay close to the second, and the pyramids which belong to it are about twenty in number. Of the pyramids of the first group there are abundant remains, and it is easy to see that they reproduce all the characteristics and all the angles of orientation with which we are familiar from the pyramids of Gebel Barkal and Nūrī, together with some others. Here, as at Gebel Barkal and Nūrī, and the pyramid field to the north-east of the ruins of the temple of Meroë, we find a “step” pyramid larger,

better built, and better planned than the other pyramids which stand near, and in each place this "step" pyramid has an orientation angle of 129° .

In Northern Egypt, as is well known, all the pyramids are oriented east and west; and observations show that in Southern Egypt the "step" pyramids are oriented not east and west, but in another azimuth facing south-east, with such an amplitude that it could not have been a question of the sunlight entering the shrine. We are therefore driven to star worship. Now, the chief pyramids in Northern Egypt date from B.C. 3800 to B.C. 2600; we may expect therefore that, as the idea of pyramid building was introduced into the south from the north, the building of the "step" pyramids must have taken place at a very early date. Looking to this amplitude it has already been shown that some of the chief temples of Southern Egypt were oriented to α Centauri. Taking the "step" pyramid at Gebel Barkal with an azimuth of 129° , we have an amplitude of 39° south of east, and, not taking into account refraction and the heights of the hills on the horizon, which would tend to neutralise each other, we find the declination of a star thus observed to be $35^\circ 58'$ south, a position which the star occupied B.C. 2700. These "step" pyramids then were probably built under the influence of the kings of the XIth and XIIth dynasties, who were famous for their building operations. This date will also suit admirably from both an astronomical and an archæological aspect the temple of Piânkhi, which has a nearly identical amplitude. We have to assume therefore that Piânkhi, like many other kings, simply restored a XIIth dynasty temple. With regard to azimuths from 143° to 150° , I find that the same star, α Centauri, might still have been observed, but in this case the building of both temple and pyramid must have taken place about the period which lies between B.C. 1200 and B.C. 700. Here, in my opinion, the astronomical determination agrees with the archæological requirements.

At Nûrî, as at the other places mentioned above, we find numbers of pyramids with the orientation angles of 122° , 140° , and 147° ; and the characteristics of the pyramids having the same angle in one place are the same as those having the same angle elsewhere. At Nûrî and at Begrawîyyeh or Meroë, a considerable number of pyramids have exactly the same angle of orientation, viz., 129° , and the number is so great that it is clear that we are not dealing with a question of accident but of design. The great Lepsius came to the conclusion that the pyramids of Nûrî looked older, and were older, than the pyramids of Gebel Barkal, and my own observations made on the spot convince me that his view was right; and he might have added also that the pyramids at Meröe having the same angle of orientation as those at Nûrî are older than those which have a different angle. It has been said above that of the shrines which originally stood before the

pyramids of Gebel Barkal and Nûrî, few remains exist, but this is not the case with the pyramids of Meroë, where we have the greater portion of many of their shrines still standing *in situ*. These remains show that the shrines consisted of two, and sometimes three, chambers with narrow doorways which served, like the various sights and sections of a telescope, to direct the rays of light from the celestial body to a given spot, that spot in the case of a pyramid being the centre of the shrine where a figure of the deceased was placed. On the walls of the shrines are cut in outline figures of kings, armed with bows and arrows, and swinging clubs over the heads of a mass of people who belong to captive races, and in some few cases we have been fortunate enough to find preserved the names of the kings who built them. Now these names help us to assign a date to the pyramids on which they are found, and it is thus possible to compare the results derived from astronomical calculations based upon angles of orientation, and those which are derived from archæological experience.

For purposes of convenience the so-called kings of Ethiopia have been divided into four groups :—

1. The dynasty of Piânnhi which ruled in the eighth century B.C.
2. The dynasty of Tirhakah which ruled about a century later.
3. The earlier kings of Meroë who ruled from about B.C. 500 to the end of the Ptolemaic period.
4. The later kings of Meroë who ruled from the beginning to the middle of the Roman domination over Egypt.

Of each of these groups of kings monuments, *i.e.*, temples and pyramids, have been found, and there can be no doubt whatever about this, for a number of royal names belonging to each of these four groups have been found inscribed upon them. We have already seen that some of the temples and pyramids of Gebel Barkal belong to the period which lies between B.C. 800 and B.C. 600, and it is now clear that some of the pyramids of Meroë belong to the period which lies between B.C. 500 and A.D. 200. Here, again, the orientation theory shows that any shrine built about that time would have been directed to the important south star Fomalhaut. Now we may see from Dr. O. Danckwörth's important inquiries concerning the precessional change of place of forty-six fundamental stars from B.C. 2000 to A.D. 800,* that at zero time the declination of Fomalhaut was 39° south, and that it was slowly changing. So that a difference of 1° to 40° south would give us B.C. 300, and to 38° would give us A.D. 200. After what I have said as to the difficulties, almost impossibilities, of determining exact azimuths, in my mind there now remains no doubt as to the time when these shrines were built. We have now to consider the

* See 'Vierteljahrsschrift der astronomischen Gesellschaft,' Leipzig, 1881, p. 76.

date of the pyramids of Nûrî, on which no inscriptions have been found, and the date of some of the pyramids of Meroë on which also no inscriptions have been found ; but before we can arrive at any conclusion on these points, we must briefly consider the question of the ancient civilisation of the Sûdân and its origin.

In the first place we must put aside the name Ethiopian which is so often applied to it, because there is no evidence whatever to show that it is of Ethiopian origin ; the term "Ethiopian" has been loosely applied to the ancient peoples of the Eastern Sûdân and their works, just as to any object the source of which was unknown the name "Phœnician" or "Hittite" has been applied in our own day. The ancient tribes who lived on the east bank of the Nile from Wâdî Halfa to Khartûm were not negroes, and they had but little in common with the tribes who lived south and west of Khartûm ; indeed they were not a black race at all. The colour of the men's skins was red, not black, and that of their women, who did not expose themselves to the sun's rays, was of a yellowish-red. Between these peoples and the ancient Egyptians a more or less friendly intercourse existed from the earliest times ; otherwise how could the Egyptian officials who were sent to the Sûdân, to the district of "big trees," to bring back huge tree trunks to cut up for coffins and sarcophagi for their royal masters, have succeeded in their enterprises ? Men sent upon missions of this kind must have followed the course of the river, for the shorter desert routes were quite impossible, at any rate on the return journey for men laden with baulks of timber. Still more remarkable is the fact that a high official, called Ba-ur-Tattu, in the reign of Assa, about B.C. 3300, travelled as far south as the land of the pygmies, and brought back one of these folk for the king ; and eighty years later Heru-Khuf, a governor of Abu, or Elephantine, did the same thing. It is difficult to imagine that Egypt could have exercised any great power over the country south of Wâdî Halfa, but that there should have been a relatively brisk intercourse between Egypt and the Sûdân for trading purposes is only natural. Again, if the Egyptians made any colonies in the south, the introduction of Egyptian civilisation and religious ideas would inevitably follow, and intermarriages between Egyptian strangers and natives would take place. Moreover, the natives who visited Egypt would bring back with them new ideas, which in course of time they finally adopted, adding such modifications as their opinions dictated. The Egyptian viceroys and Sûdân princes would naturally build temples and tombs (*i.e.*, pyramids) after the manner of those they found in Egypt, but the orientation of these would be altered in accordance with the religious views of those who built them. But suitable sites for temples and pyramids are more rare in the Sûdân than in Egypt, and priests in both countries were unwilling to abandon a spot which had become associated with sacred beliefs

or religious worship. For this reason they were driven to various shifts in order to make an old temple suitable for modern requirements ; and when no amount of modification would suffice they eventually pulled it down, in whole or in part, and rebuilt it on the same site as the old one.

Since constant intercourse existed between Egypt and the Sûdân in very early times, and since the people of the one country were influenced greatly by those of the other, it is clear that there is no reason why certain of the Sûdân pyramids should not be as old almost as those of Egypt. On this point both astronomy and archaeology agree, and I find, on comparing the tables in the 'Dawn of Astronomy' and the deductions which the author has made from them with my own observations made from an archaeological standpoint, that our conclusions are identical. I may therefore say finally that we seem to be in the presence of three different sets of structures which were built at three different times. The oldest dates from the XIIth dynasty, when α Centauri was used as a warning star ; the second from B.C. 1200 to B.C. 700, the same warning star being used ; and, finally, a third group much later, when the star Fomalhaut could be observed on the horizon with the identical amplitude first employed. Tables have been prepared showing the various azimuth amplitudes and declinations, with corrections for refraction and for hills on the horizon, which are estimated at 1° or 2° in height ; but it is not necessary to give them in this place because of the local difficulties in determining the azimuths, to which I have already referred.

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The following table of amplitudes, &c., I owe to the kindness of Professor Sir Norman Lockyer, K.C.B., F.R.S.

Table of Amplitudes of Pyramids.

	Lat.	No. on Dr. Budge's plans.	Orientation from north through east.	Amp.	Pecilination (south).		
					No. correction.	Correction for refraction hill, 1° high.	Correction for refraction hill, 2° high.
Pyramids at Gebel Barkal (facing S.E.)	18° 30' N.	1	129°	39	36° 33'	36° 24'	35° 58'
		2	140	50	46 36	46 18	45 47
		3	140	50	46 36	46 18	45 47
		4	140	50	46 36	46 18	45 47
		5	122	32	30 10	29 56	29 32
		6	147	57	52 42	52 22	51 46
Tirhakah's temple Piânhki's	7	139	49	45 42	45 21	44 56	
	..	143	53	49 14	48 55	48 23	
	..	127	37	34 48	24 34	34 8	
Pyramids at Nûri	18° 24' N.	1–6	129	39	36 39	36 26	35 59
		..	129	39	36 39	36 26	35 59
Small temple (facing . S.E.)	129	39	36 39	36 26	35 59
	
Pyramids of Begrawiyeh (facing S.E.)	17° N.	..	129	39	37 0	36 47	36 22
		8	144	54	50 42	50 25	49 53
			129	39	37 0	36 47	36 22
			139	49	46 12	45 57	45 28
			140	50	47 6	46 52	46 21
			147	57	53 20	53 2	52 28

5½° magnetic variation allowed for in Dr. Budge's orientations. Latitudes taken from map. Nûri taken as 11 miles south of Gebel Barkal (18° 30').



A PYRAMID AT GEREL BARKH.